

Hake MSE: past, present, and future

JMC meeting

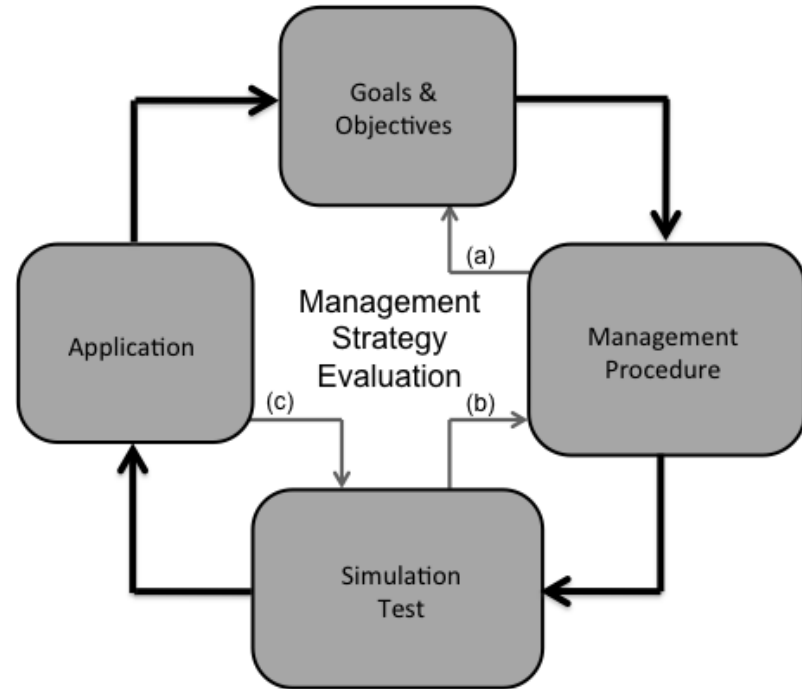
March 5, 2018

Kristin Marshall - NOAA NWFSC MSE Coordinator

kristin.marshall@noaa.gov

Reminder: MSE is a process

- ▶ Simulates the entire management process
 - ▶ Data collection
 - ▶ Assessment
 - ▶ Application of harvest control rules
 - ▶ Effect of removals on abundance, distribution, productivity
- ▶ Communication throughout the process is key



Reminder: MSE is meant to improve decision making

- ▶ Testing the performance of management procedures (data collection, assessment, application of harvest strategies) over:
 - ▶ Many replicate “futures”
 - ▶ Future scenarios capturing “things we can’t control”, e.g. changes in productivity, recruitment, natural mortality, spatial distribution
 - ▶ Alternative hypotheses about how the fishery system functions
- ▶ Testing management procedures first in a virtual world, before considering implementing them the real world is part of due diligence
- ▶ MSE is not meant to inform tactical decision-making

Outline

- ▶ Previous iterations of the Hake MSE
- ▶ Status update and work plan
- ▶ An initial proposed structure for further MSE development

Previous iterations of the Hake MSE

▶ MSE Goals:

- ▶ Defining objectives of the fishery and performance metrics,
- ▶ Developing understanding of short-term and long-term implications of harvest control rules for Pacific hake
- ▶ Explore importance of sampling and shifts in sampling (age-1 index of abundance)
- ▶ Explore how a shift in age structure toward younger fish limits biomass of older hake in Canada

Previous iterations of the Hake MSE

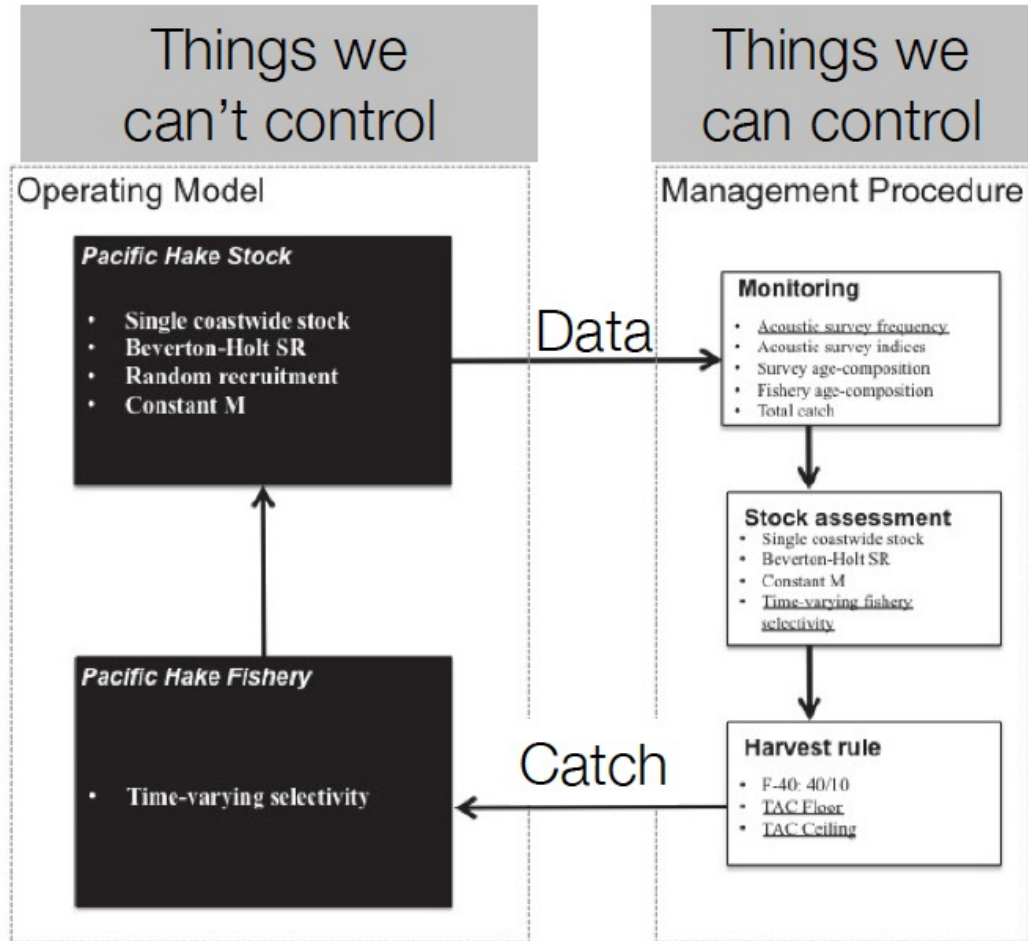
▶ Management Objectives:

- ▶ The offshore Pacific Hake resource is above a certain threshold to allow for a sustainable population and sufficient numbers in a diversity of age classes. A threshold may be defined as a level that does not impair recruitment.
- ▶ Both parties can achieve their intended benefits.

▶ Performance indicators:

- ▶ Median average depletion
- ▶ Probability SSB/ B_0 is below 10%, between 10% and 40%, and above 40%
- ▶ Median average catch
- ▶ Average annual variability in catch
- ▶ Probability that fishery is closed
- ▶ Probability catch is above or below a threshold

Previous simulation set-up



Lessons learned

- ▶ MSE was a useful approach to understand the implications of decisions about model structure and parameters in the assessment model
 - ▶ The *F40%* harvest rate has rarely been applied in practice
 - ▶ Potential for large recruitment events creates variability
 - ▶ Catch ceilings seem potentially useful
 - Slight higher long-term fishery yield
 - Lower conservation risk
 - Lower annual variation in catch
 - ▶ Catch floor has a risky aspect
 - Higher conservation risk
 - Lower annual variability in catch

Limitations

- ▶ Operating models and assessment model were nearly identical
- ▶ Non-spatial operating model unable to address distribution objectives

Current status update and work plan

- ▶ MSE Process:
 - ▶ Personnel update
 - ▶ Proposed communication plan
- ▶ Work plan

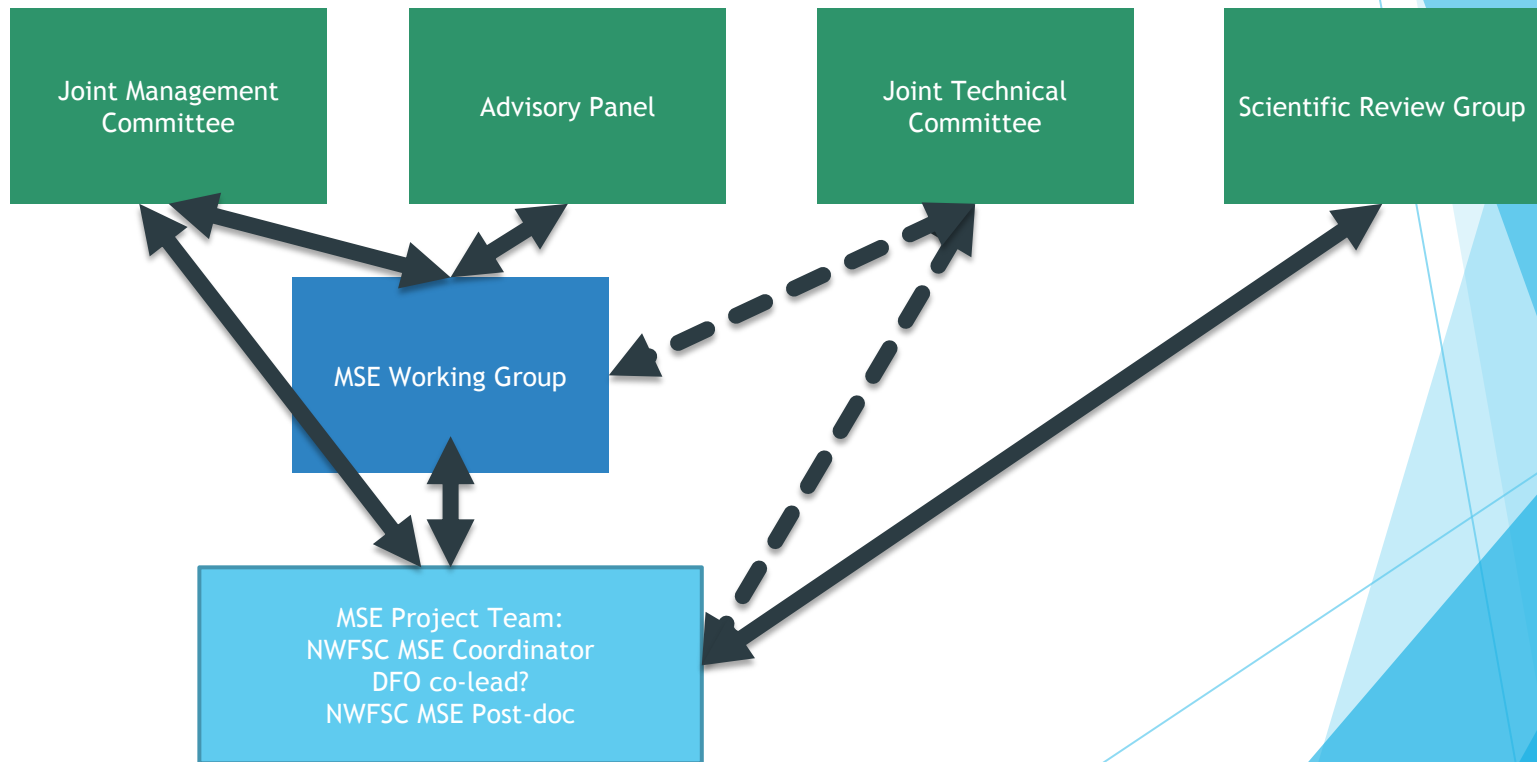
2017 SRG Recommendations on MSE process:

- ▶ The SRG believes that it is important that development of operating models and overall framework for the MSE be compatible with the assessment model and programming techniques used by the JTC. Therefore, **we strongly recommend that the JTC have at least an oversight role in the development of operating models and corresponding revisions to the MSE framework.** The acoustic survey team also is expected to have a role in data development for this process. The SRG should not have a role in this development process as it is the primary review body under the Agreement and is expecting to review MSE results as they become available. The SRG has no specific guidance regarding the role of a contractor in the MSE process except to note that the level of resources allocated to the task may alter the delivery timeline regardless of who conducts the analysis.
- ▶ As the MSE process proceeds, it is important to **coordinate the hake survey and other ecological investigations to ensure that priority data are collected to inform the operating model**, for example, with information about seasonal occurrence of Pacific Hake.

Hake MSE personnel/resources update

- ▶ NOAA Fisheries and the Environment (FATE) funded project: Short-term forecasting of Pacific hake distribution in the California Current Ecosystem, Lead PI Mary Hunsicker, NWFSC post-doc Mike Malick
- ▶ NWFSC MSE coordinator - Kristin Marshall
- ▶ NWFSC Hake MSE post-doc started Feb 1 - Nis Jacobsen

Proposed communication plan for MSE



The background of the slide features abstract, overlapping geometric shapes in various shades of blue, ranging from light sky blue to deep navy blue. These shapes are primarily located on the right side of the slide, creating a modern, dynamic feel.

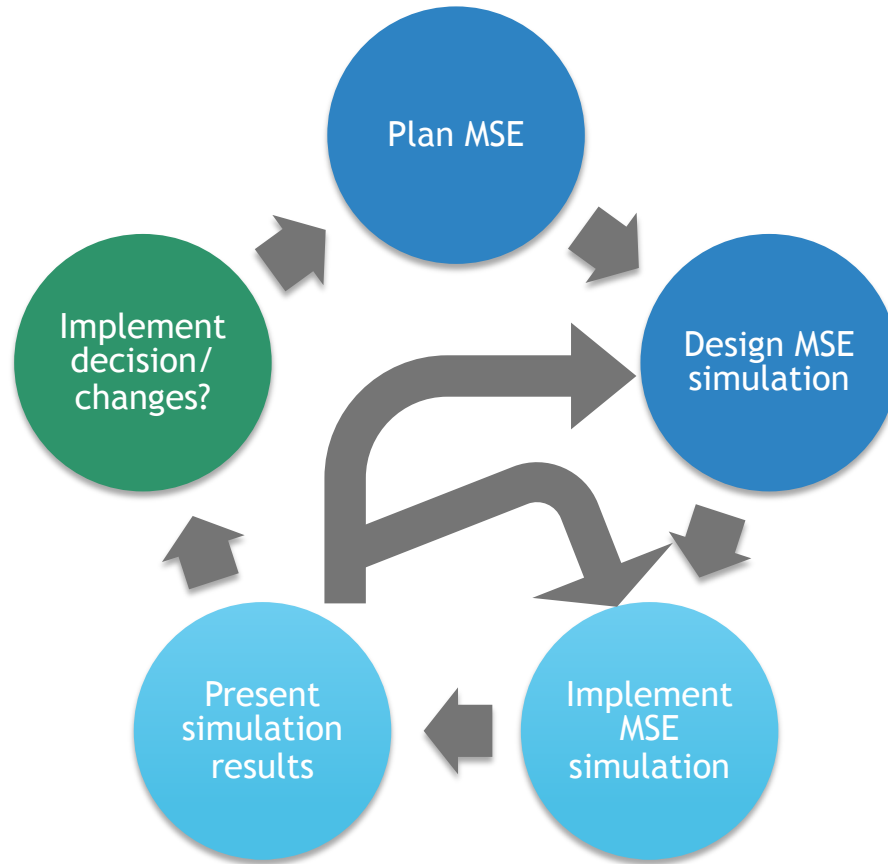
Work plan for this iteration of Hake MSE (thru Dec 2019)

2017 SRG Recommendations on MSE approach:

- ▶ Develop **measurable management objectives** (conservation, fishery, etc.) and **performance indicators** to measure their achievement. These objectives are important because they are the basis for evaluating the performance of a management procedure and the robustness of a management procedure across a range of uncertainties.
- ▶ Measureable objectives consist of three components: (1) a target or threshold value (e.g., for abundance, variation in catch), (2) a time horizon for measurement, and (3) an acceptable probability of either achieving a target or avoiding a threshold. The process of developing these objectives is not a scientific exercise, although it can be informed by science. At this stage, nonetheless, **the SRG recommends that the JTC develop provisional objectives and performance metrics** based on feedback to date. These provisional objectives will provide a range of options for consideration, modification and approval by the JMC and AP.

2017 SRG Recommendations (cont.)

- ▶ The SRG recommends the development of a **spatially structured (or spatially explicit) operating model** that can capture seasonal effects and potential climate forcing influences on stock and fishery dynamics. The fleets-as-area approach is viewed as a possible alternative approach to structuring an assessment model, but is not suitable for development of an operating model in the MSE context.
- ▶ The SRG reiterates its previous recommendation that a spatially explicit operating model is needed for the MSE process, given the types of questions that the JMC has raised. This is consistent with the outline of Option B described by S. Cox (Attachment 3). Since the operating model represents a hypothesis about the state of nature, the SRG notes that **multiple operating models** may be developed representing different plausible population dynamics, environmental conditions and other drivers of hake abundance and distribution (also termed 'states of nature'). A three-year timeline is expected for development of the OM. This timeline could be changed by the level of resources allocated to the task.
- ▶ Some factors to consider in the development of the operating model include seasonality, **environmental drivers of hake dynamics, migration behaviour, fleet behaviour, and interactions between areas**. Such issues need to be carefully considered in the development phase so as not to limit further development in the future.
- ▶ **Documentation** of the design and technical implementation of MSE components (operating models, management procedures) is necessary to ensure scientific **credibility, continuity and maintainability** as personnel involved in the process changes.



Plan and Design I (thru March 2018)

1. Establish project team and MSE Work group, roles and responsibilities, communication strategies, work plan (by March 2018)
2. Establish goals for this iteration of the MSE (What problem are we trying to address?) (by March 2018)

Deliverables: a written statement approved by the JMC that defines the goals for this iteration of the Hake MSE

Plan and Design II (thru Aug 2018)

3. Review goals and objectives of managers with feedback from MSE working group
4. Review performance metrics with feedback from MSE working group
5. Develop environmental scenarios
6. Identify other types of scenarios (?)
7. Develop operating and estimation models

Deliverables: documented management objectives and performance metrics agreed upon by JMC, a preliminary (not conditioned) operating model

Implement MSE simulation (thru Dec 2019)

8. Develop computer code for closed loop simulation
9. Parameterize operating models
10. Simulate each management strategy with each operating model and summarize and interpret performance metrics
11. Develop communication tools for simulation results

12. Present simulation results

- ▶ *Deliverables:*

- ▶ *First iteration, with a single non-conditioned model - Aug JMC meeting 2018*
- ▶ *Second iteration, with at least one conditioned model - Feb/March 2019*
- ▶ *Third iteration, with multiple conditioned models - Aug 2019*

13. Technical documentation of results - by Dec 2019

Proposed MSE structure

Proposed MSE goals

- ▶ Evaluate the performance of current hake management procedures under alternative hypotheses about current and future environmental conditions
- ▶ Better understand the effects of hake distribution and movement on both countries' ability to catch fish
- ▶ Better understand how fishing in each country affects the availability of fish to the other country in future years

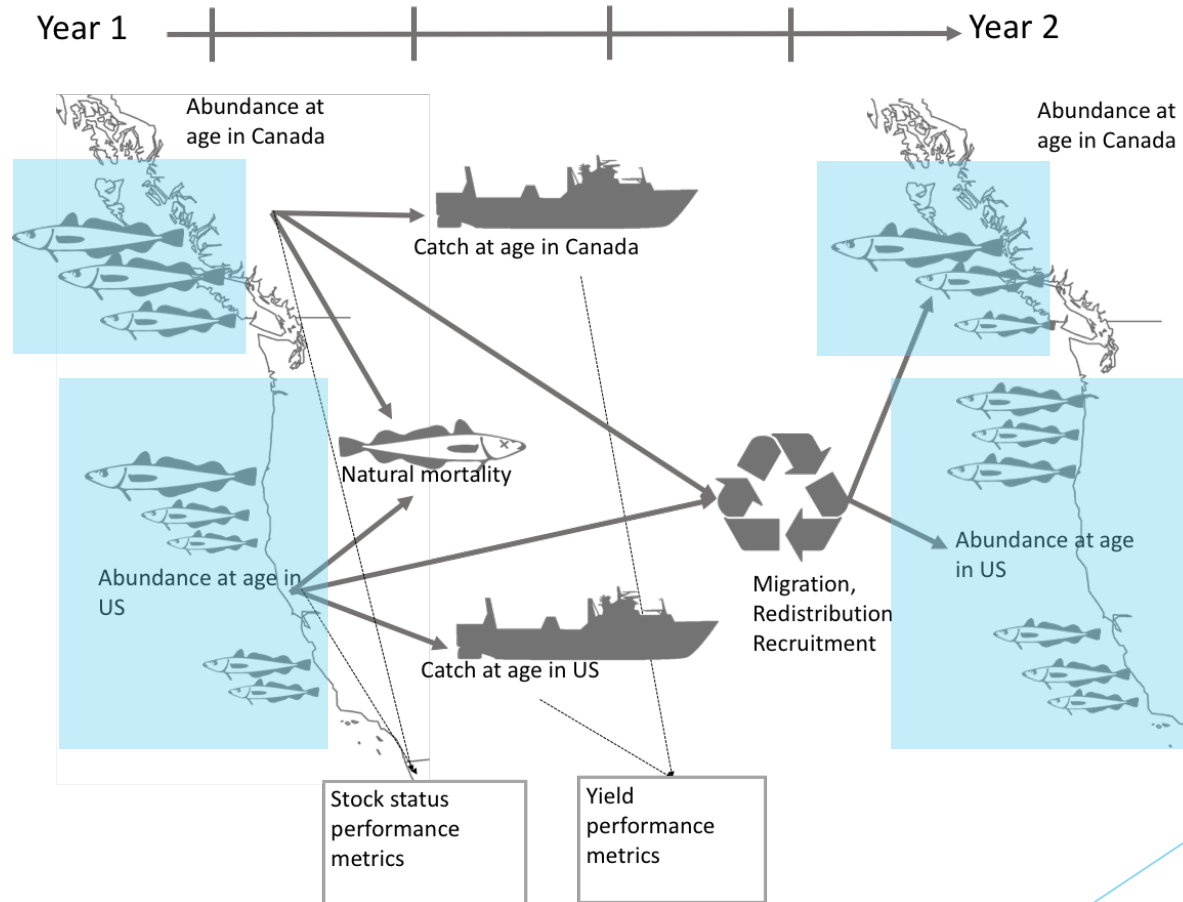
Proposed objectives and performance indicators

- ▶ Management Objectives:
 - ▶ The offshore Pacific Hake resource is above a certain threshold to allow for a sustainable population and sufficient numbers in a diversity of age classes. A threshold may be defined as a level that does not impair recruitment.
 - ▶ Both parties can achieve their intended benefits.
- ▶ Performance indicators (over short term and long term):
 - ▶ Median average depletion
 - ▶ Probability SSB/B_0 is below 10%, between 10% and 40%, and above 40%
 - ▶ Median average catch (*by area*)
 - ▶ Average annual variability in catch (*by area*)
 - ▶ Probability that fishery is closed
 - ▶ Probability catch is above or below a threshold (*by area*)

Proposed management procedures to test

- ▶ Data collection: acoustic survey frequency (every 1, 2, or 3 years)
- ▶ Assessment model structure: coastwide, fleets as areas, or fully spatial assessment model
- ▶ HCR: current $F_{SPR}=40\%$ with the 40:10 adjustment (with implementation uncertainty)

Proposed operating model

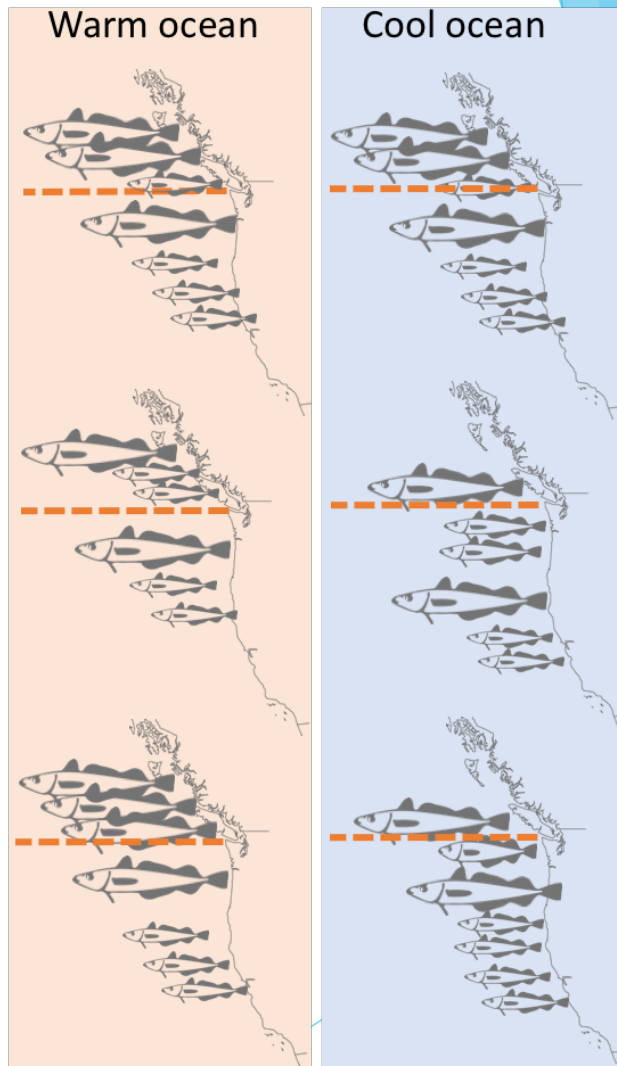


Alternative hypotheses for movement (operating models)

Age-based movement

Climate-based movement

Age- and Climate-based movement



Potential Environmental Scenarios

- ▶ Interannual variability in ocean conditions
- ▶ Long-term climate-driven changes in ocean conditions
- ▶ Development will be influenced by FATE project results

Next steps (thru Aug 2018):

- ▶ JMC finalizes goals for this iteration of the MSE
- ▶ Refine proposed MSE structure in coordination with JMC and AP (in MSE working group?):
 - ▶ Focused review/discussions on management objectives and performance indicators as needed
 - ▶ Discussion on operating model considerations: Hake population dynamics and fishery dynamics
 - ▶ Discussion on environmental and other scenarios to explore
- ▶ Develop spatial operating model with age-based movement